Data Acquisition for Physics with Arduino

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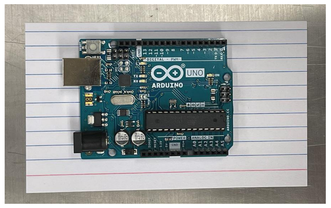
Background

- Arduino is an open-source electronics micro-controller board
  - Enables us to interface technology with our environment
  - Programmable using the Arduino Integrated Development Environment (IDE)
- The Arduino's size, portability, and functionality make it very useful for data collection for physics
  - Size is slightly smaller than an index card
  - The small form factor makes it highly portable. It can practically be taken and used anywhere
  - It is very powerful and easily interfaces with all our physics laboratory equipment

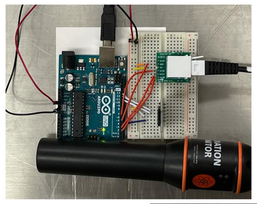


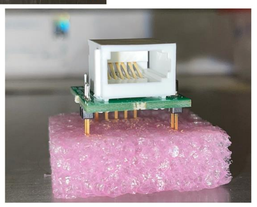
The Goal

- We are developing a data acquisition system using Arduino
  - Gives users total control of data collection
- Arduino allows data to be exported to external storage devices
  - SD Card Modules are cheap and simple to program
- Most importantly, Arduino easily integrates with the equipment found in our physics laboratories
  - Compatible with the Vernier sensors used in our physics labs

Circuit Development

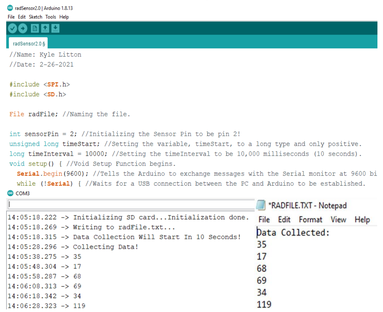
- Implemented the Digital Protoboard Adapter from Vernier
  - Allows us to interface Vernier Digital Sensors with Arduino
- The sensors are connected to Arduino through electronic circuitry
  - The adaptor passes through the signal from the sensors to the Arduino.
  - The user must write a program to interpret and analyze the signals received from the sensors





Software Development

- Our data acquisition system is still in its infancy
  - Decided to start small with a proof of concept
  - Create a data collection system for the radiation sensor
- Proof of Concept Goals
  1. Count the number of radiation events that occurred over a set time interval
  2. Test exporting the data to an external storage device (a .txt text file on an SD card)



```
radSensor2.0 | Arduino 1.8.13
File  Edit  Sketch  Tools  Help
radSensor2.0 §

//Name: Kyle Litton
//Date: 2-26-2021

#include <SPI.h>
#include <SD.h>

File radFile; //Naming the file.

int sensorPin = 2; //Initializing the Sensor Pin to be pin 2!
unsigned long timeStart; //Setting the variable, timeStart, to a long type and only positive.
long timeInterval = 10000; //Setting the timeInterval to be 10,000 milliseconds (10 seconds).
void setup() { //Void Setup Function begins.
  Serial.begin(9600); //Tells the Arduino to exchange messages with the Serial monitor at 9600 bi
  while (!Serial) { //Waits for a USB connection between the PC and Arduino to be established.
```

```
COM6

14:05:18.222 -> Initializing SD card...Initialization done.
14:05:18.269 -> Writing to radFile.txt...
14:05:18.315 -> Data Collection Will Start In 10 Seconds!
14:05:28.296 -> Collecting Data!
14:05:38.275 -> 35
14:05:48.304 -> 17
14:05:58.287 -> 68
14:06:08.313 -> 69
14:06:18.342 -> 34
14:06:28.323 -> 119
```

```
*RADFILE.TXT - Notepad
File  Edit  Format  View  Help
Data Collected:
35
17
68
69
34
119
```

Educational Implications

- Morehead State's Physics department is working to integrate PICUP across the curriculum
  - Our data collection system could play a role in enhancing student understanding of computation in physics through advanced lab experiments
- My personal experience
  - Built upon fundamental knowledge of programming developed in previous courses
  - Arduino was a new platform, and I was able to pick it up quickly with limited background knowledge

PICUP — Partnership for Integration of Computation into Undergraduate Physics

Summary & Outlook

- Proof of concept for a data acquisition system for physics is complete
- Laid the groundwork for future research and classroom educational projects
- What's next?
  1. Integrate our data collection system into some of our more advanced physics lab experiments
  2. Expand our system design to collect data for rotational motion

References

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